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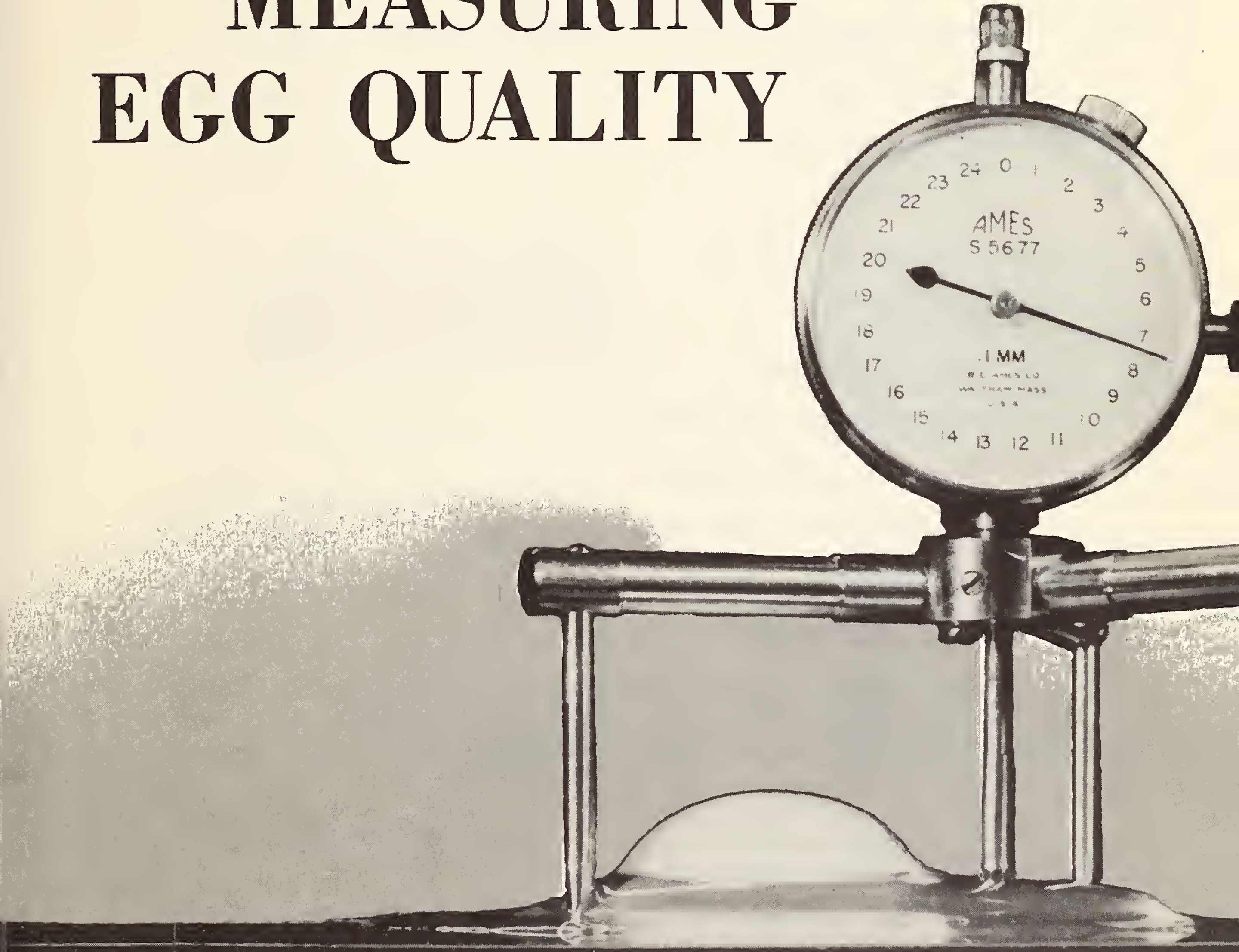
Equipment and Methods for MEASURING EGG QUALITY



U. S. DEPARTMENT OF AGRICULTURE · AGRICULTURAL MARKETING SERVICE · WASHINGTON, D. C.

POULTRY DIVISION

AMS No. 246

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Revised June 1960

EQUIPMENT AND METHODS
FOR
MEASURING EGG QUALITY

By

Lester Kilpatrick, Poultry Division, Agricultural Marketing Service;
Albert W. Brant, Agricultural Research Service;
and Harlan L. Shrader, Federal Extension Service[1]

Introduction

The purpose of this bulletin is to describe methods and equipment suitable for use by breeders, egg producers, market men and others who are concerned with quality measurement of eggs.

For many years research workers have been experimenting with methods of determining the interior quality of eggs that are more objective than the time-honored system of segregating quality by candling.

At the present time a method of marketing a pack of uniformly high quality eggs has been developed by private and governmental marketing agencies. The crux of this plan is the use of an objective quality-measuring method, such as that described in this report, together with constant temperature and humidity controls. This new approach is now feasible because large numbers of eggs are being produced by hens that are bred, fed, and managed in a manner conducive to the production of uniformly high quality eggs, and egg handling methods are being used which effectively retain the high initial quality.

Measuring Shell Quality

Cleanliness.--The producer has the initial responsibility for the production of clean eggs. Soiled eggs must be satisfactorily cleaned or sold at a discount. Practically all standards--Federal, State or private--require that top quality eggs be clean.

Shell texture, shape, and strength.--The market man can control these factors by removal of abnormal eggs as they move over the packaging line. The breeder, however, is concerned with reducing the number of abnormal eggs produced by his stock. He needs hens capable of forming an egg shell strong enough to carry its contents to the consumer without cracking under normal handling conditions. One easy method of estimating strength is to measure the thickness of the shell. Figure 1 shows a thickness gage[2] that, with a little modification, does the job satisfactorily. These gages were designed to measure the thickness of paper; therefore, the jaws are flat. Since egg shells are not flat it is necessary to remove the flanged tip from the upper jaw and round it off with a file or on an emery wheel. When measuring egg shells always place the rounded jaw on the inner surface of the shell.

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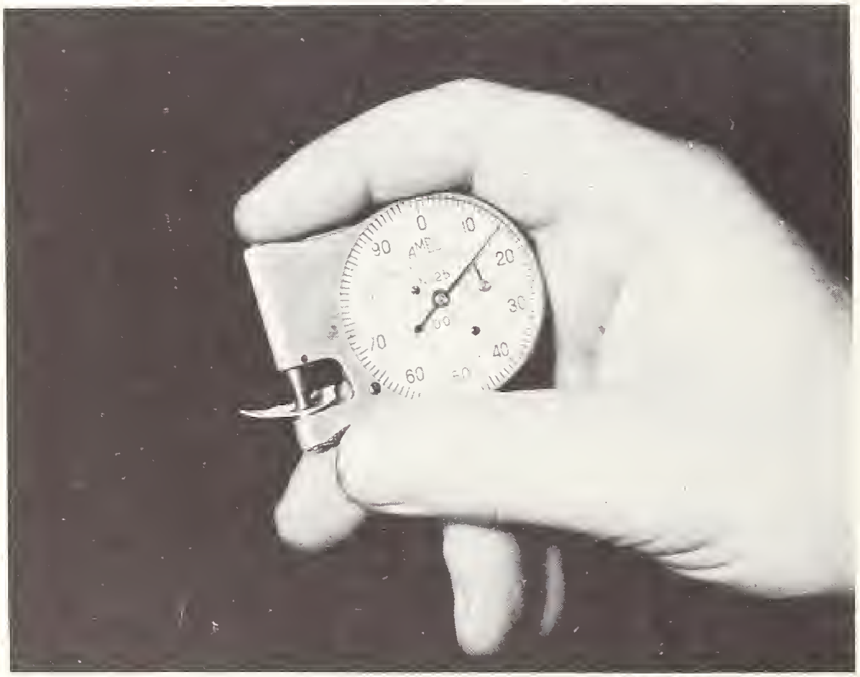
[1] An earlier publication "How to Measure Egg I.Q." was prepared by A. W. Brant and H. L. Shrader. Dr. Brant is now associated with the Department of Food Science and Technology, University of California. Mr. Shrader has retired.

Remove a piece of shell, place it between the jaws of the gage, and read the figures on the scale. This measurement requires only a few seconds. Use samples of shell from different parts of the egg to locate the thinnest section. Many times this will be either the large or small end. If the measurements from the ends and center sections of the shell are the same, it is easier to use only the center portion. It is usually easier to leave the shell membranes on the piece of shell when measuring. In testing the shells from a certain hen be sure to take the piece of shell from about the same area each time. Shells thinner than .013 of an inch (0.34 mm.) are poor risks in market channels. Shell defects such as wrinkles, ridges, rough areas, and body checks can be recorded along with shell thickness.



BN 6239X

Figure 1.--Paper thickness gage for measuring shell thickness.

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[2] The Poultry Division, Agricultural Marketing Service, Washington 25, D. C., will furnish names of known suppliers of this equipment on request.

Measuring Albumen Quality

Equipment.--For economy in time and preservation of the product, the following equipment should be available to persons engaged in breaking eggs for the purpose of measuring albumen height and observing yolk and albumen condition.[3]

1. A flat glass surface approximately 10" x 10" or larger. The glass should be placed on a metal stand having adjustable legs for leveling. A mirror of approximately the same size as the glass is needed for observing the under side of the egg. The stand should be set on a table of such height that the dial of the micrometer in use will be at eye level.

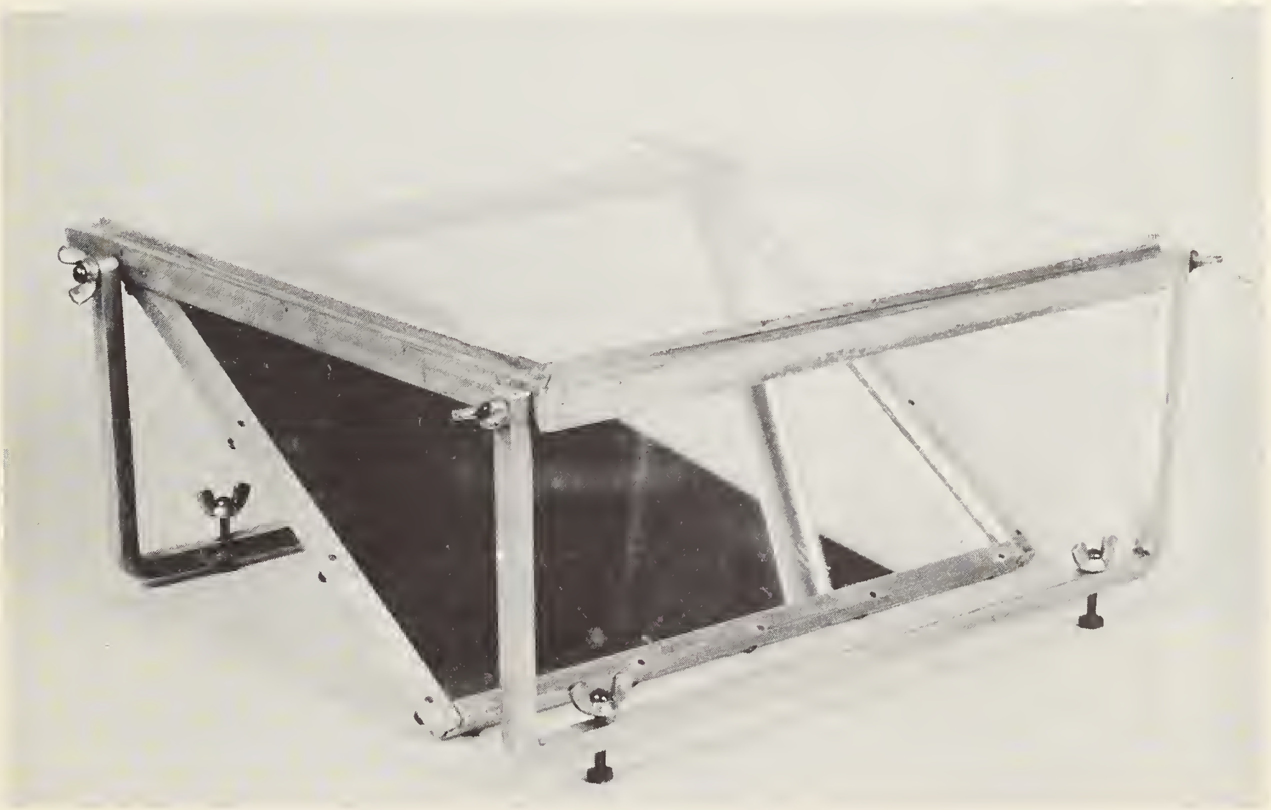

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Figure 2.--Metal stand with mirror and leveling device.

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[3] The Poultry Division, Agricultural Marketing Service, Washington 25, D. C., will furnish names of known suppliers of this equipment on request.

2. A standard individual egg scale which indicates the weight in ounces per dozen, or grams per egg. A test weight should be used to check the scale at the start of the breaking operation and any time the scale is moved.

3. A knife and breaking tray obtained from a supply house dealing in egg-breaking equipment is very convenient for opening the eggs.

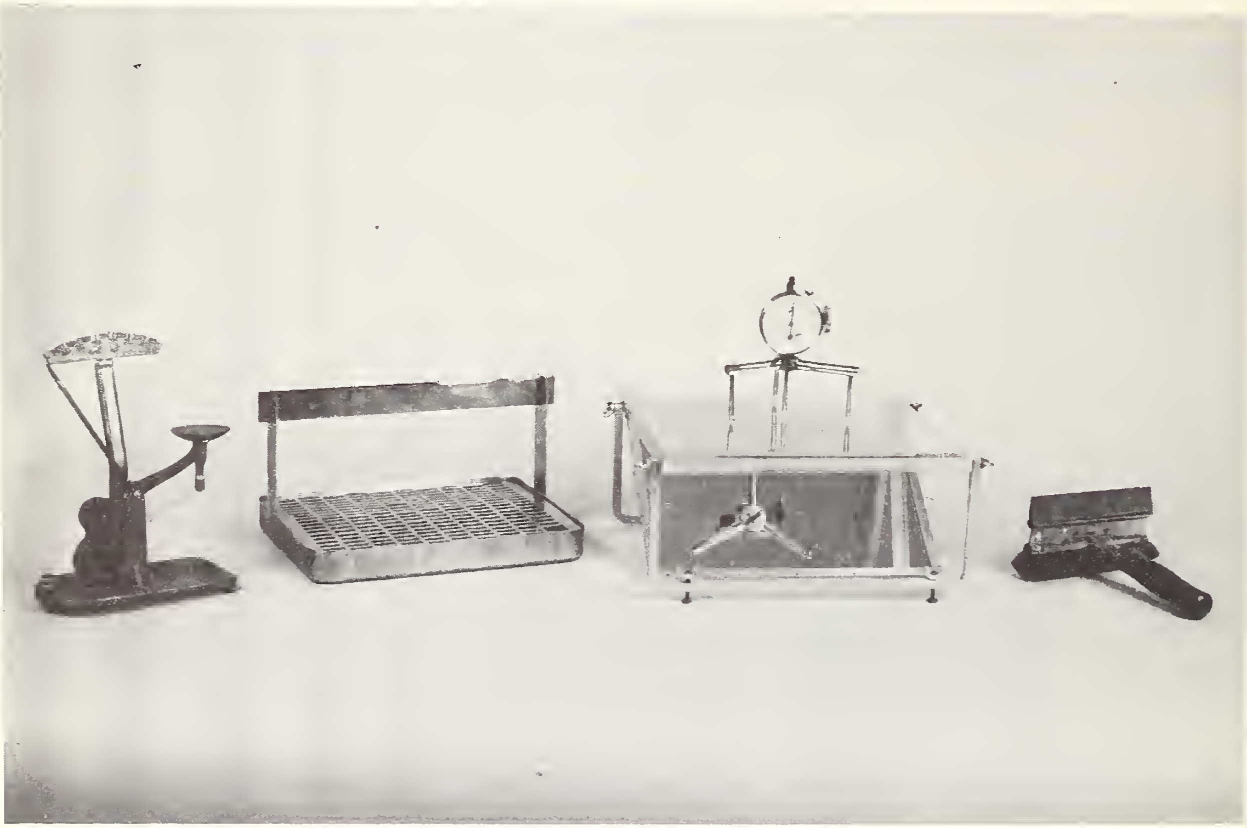

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Figure 3.--Individual egg scale, drip tray with knife, breaking stand and micrometer, squeegee.

4. A micrometer mounted on a tripod such as illustrated in figure 4 is satisfactory to measure the height of the thick albumen. It should be graduated to read in tenths of a millimeter.

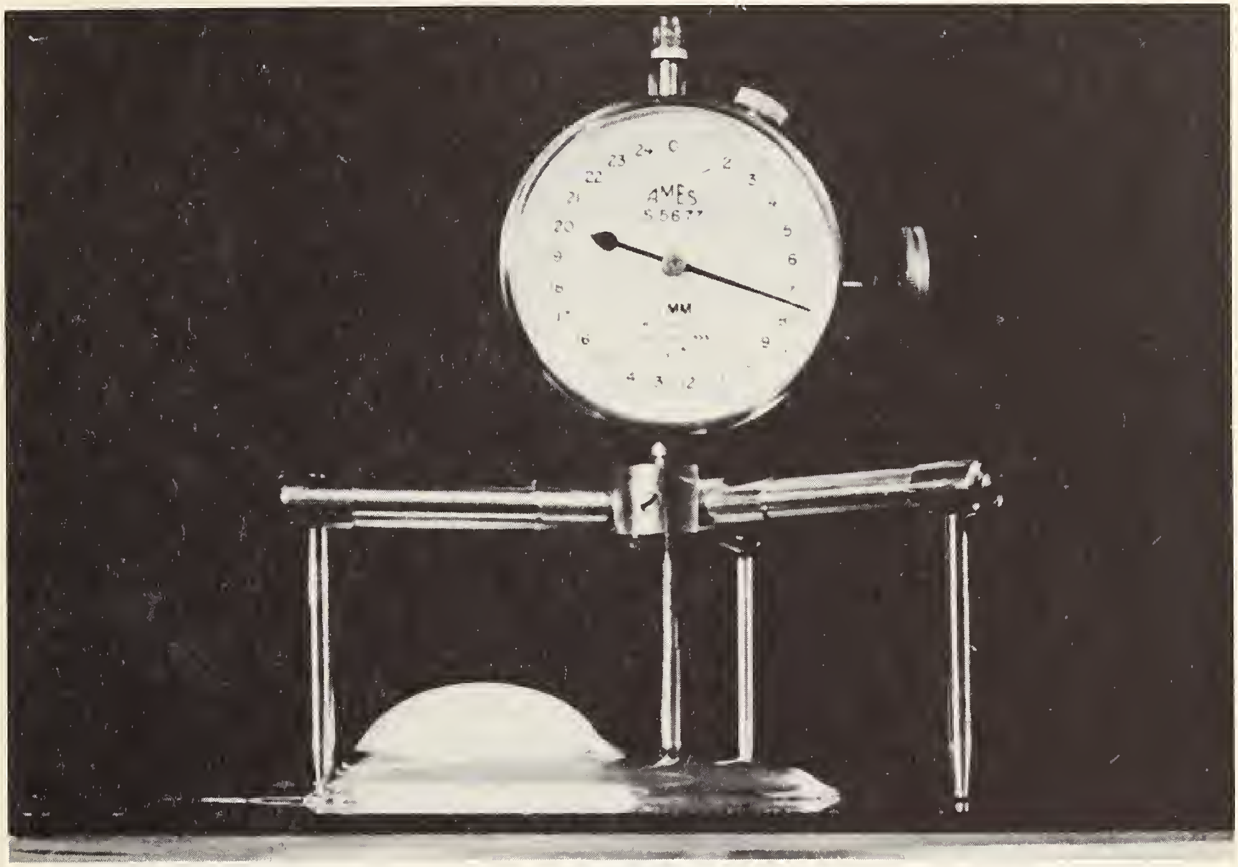

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Figure 4.--The micrometer or height gage for measuring the height of the thick white. Gage shown here in position over an egg.

5. A calculator (fig. 5) is necessary to convert the micrometer readings and egg weight into Haugh units.

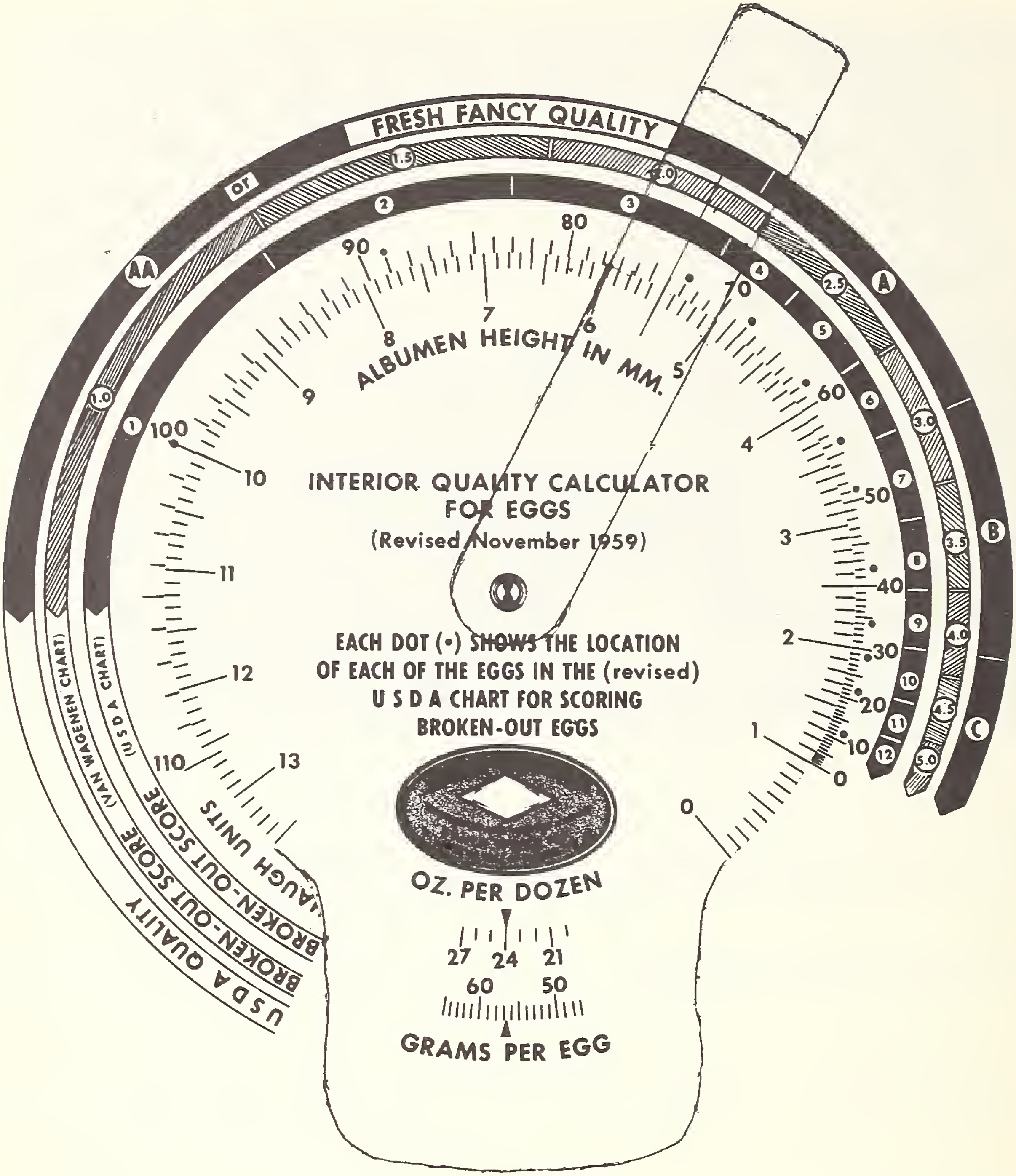

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Figure 5.--The interior quality calculator for eggs. The Haugh units are calculated from albumen height and egg weight. It also shows the relationship of Haugh units to USDA scores, Van Wagenen scores, and USDA qualities.

6. A squeegee is handy to move the broken egg from the glass surface to a suitable container.

7. Liquid containers, churning equipment, and holding facilities are needed in accordance with the disposition made of the broken-out eggs.

Procedure.--Comparable results can be obtained only if uniform procedures are used.

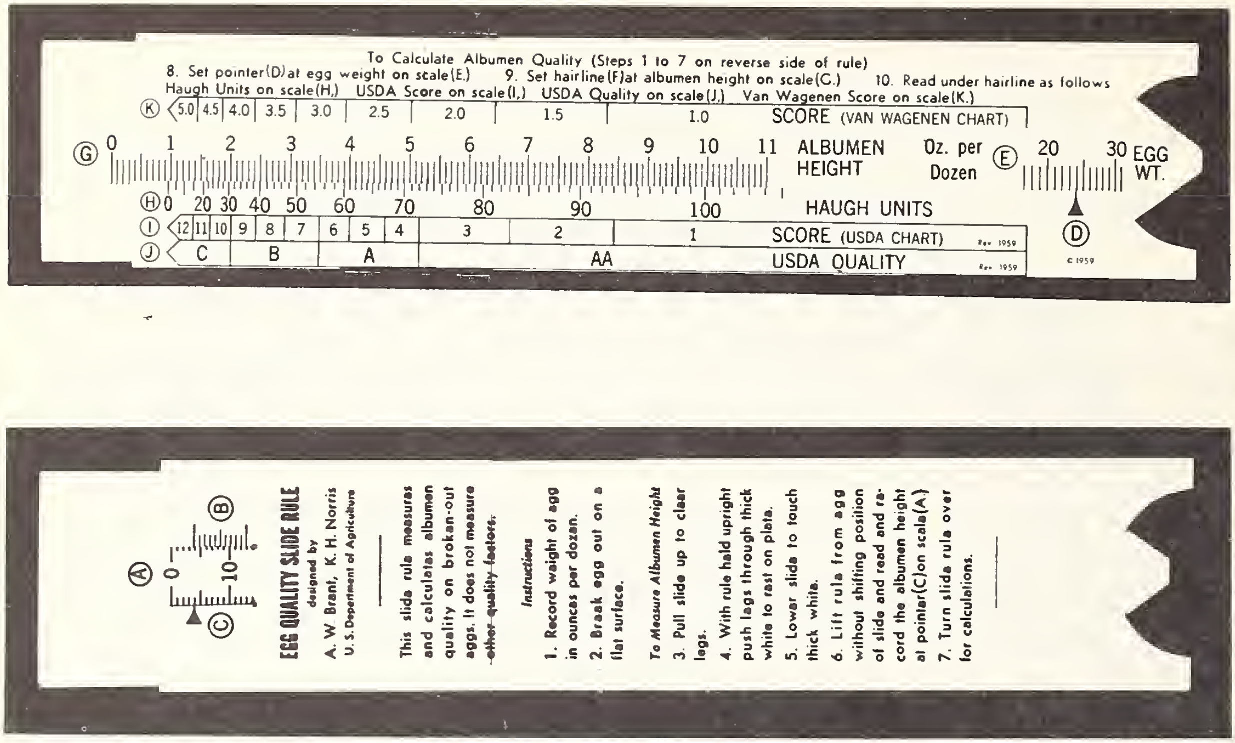
Since eggs for top quality must have practically normal shells, only such eggs are to be selected when obtaining the sample for condition examination of albumen and yolk. The eggs should be cooled or tempered to a uniform temperature. It is generally agreed that eggs should be cooled at the farm to 60° F. or below and that the temperature should not be permitted to rise above that through the marketing channels.

When using the Haugh unit value in selecting breeding stock, it is customary to weigh the egg to the nearest gram or half ounce, depending upon which type of scale is used. Since market eggs are sold on the basis of weight per dozen eggs expressed in ounces, it is customary for graders to record the weight in ounces dropping any fractions.

Care must be taken in using the breaking knife so that the thick white is not ruptured. Consistent results can best be obtained by using a breaking knife. Blunt edges, such as a table edge, may cause splintering of the shell with the possibility of puncturing the thick white. The egg should be held as near the glass as possible and the contents emptied very gently from the shell. In some eggs the envelope of thick white is rather firmly attached to the shell membrane in the small end of the egg. When this is noted, rupture of the thick white can generally be prevented by slowly raising the half shell. Albumen heights should not be recorded of eggs when the thick white has been mechanically ruptured or when the yolk membrane is ruptured for any cause.

The surface on which the egg contents are placed must be level. One egg at a time should be broken since it is important to measure the albumen height immediately after breaking. A delay of a few minutes can make a difference in the Haugh unit reading.

The micrometer must be checked before using. Set it on the glass and turn the measuring rod down until it touches the surface of the glass on which the broken-out egg will be placed. To be sure that the rod is actually touching the surface of the glass, push the edge of a thin sheet of paper against the intersection of the rod and the glass. The face of the micrometer is then turned so that the indicator will read zero. The procedure should be repeated from time to time during the breaking operation to be sure that the micrometer is properly adjusted.



To Calculate Albumen Quality (Steps 1 to 7 on reverse side of rule)

8. Set pointer(D) at egg weight on scale(E.) 9. Set hairline(F) at albumen height on scale(G.) 10. Read under hairline as follows Haugh Units on scale(H.) USDA Score on scale(I.) USDA Quality on scale(J.) Van Wagenen Score on scale(K.)

EGG QUALITY SLIDE RULE
designed by
A. W. Brant, K. H. Norris
U. S. Department of Agriculture

This slide rule measures and calculates albumen quality on broken-out eggs. It does not measure ~~other quality factors.~~

Instructions

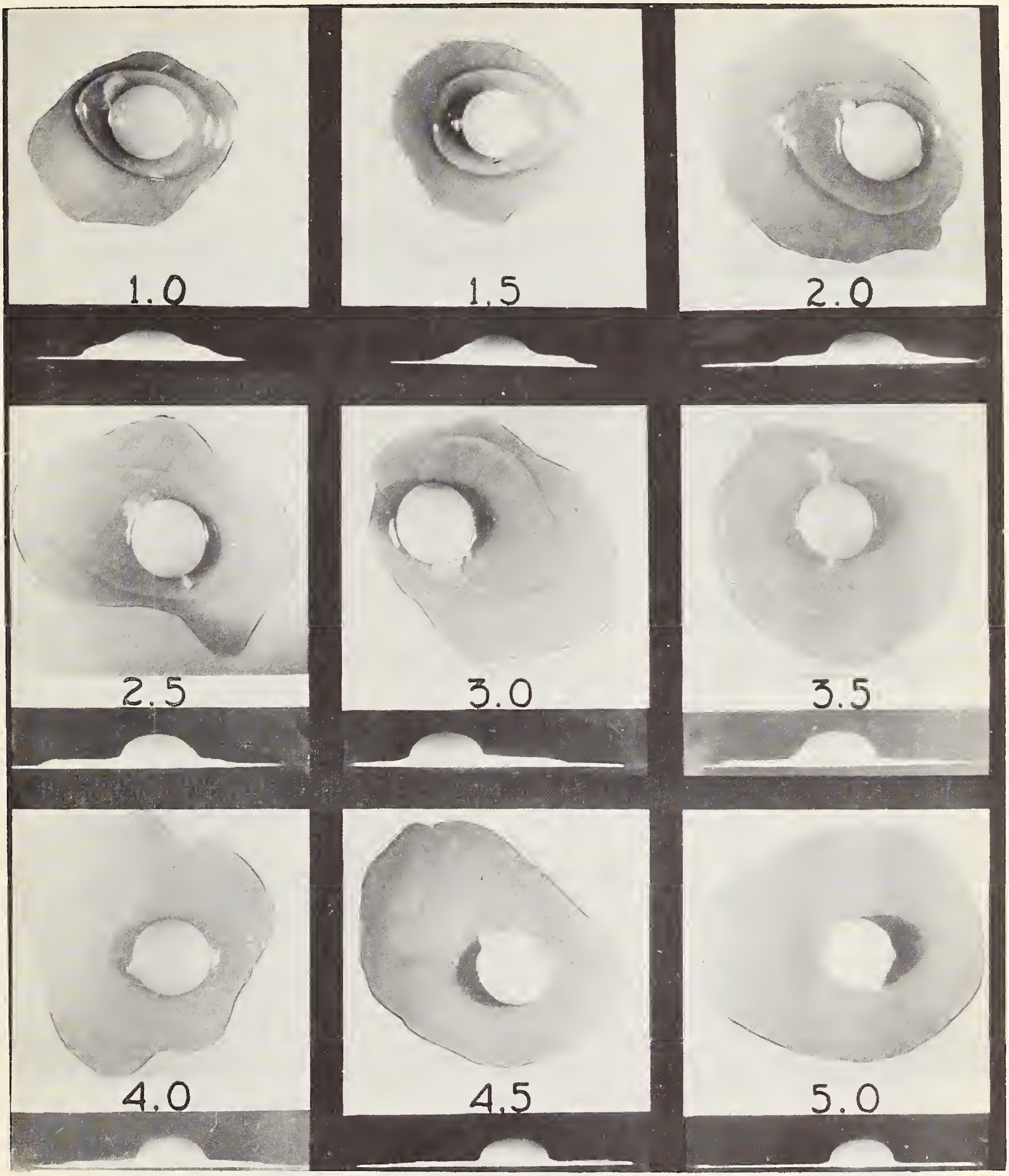
1. Record weight of egg in ounces per dozen.
2. Break egg out on a flat surface.

To Measure Albumen Height

3. Pull slide up to clear legs.
4. With rule held upright push legs through thick white to rest on plate.
5. Lower slide to touch thick white.
6. Lift rule from egg without shifting position of slide and read and record the albumen height at pointer(C) on scale(A.)
7. Turn slide rule over for calculations.

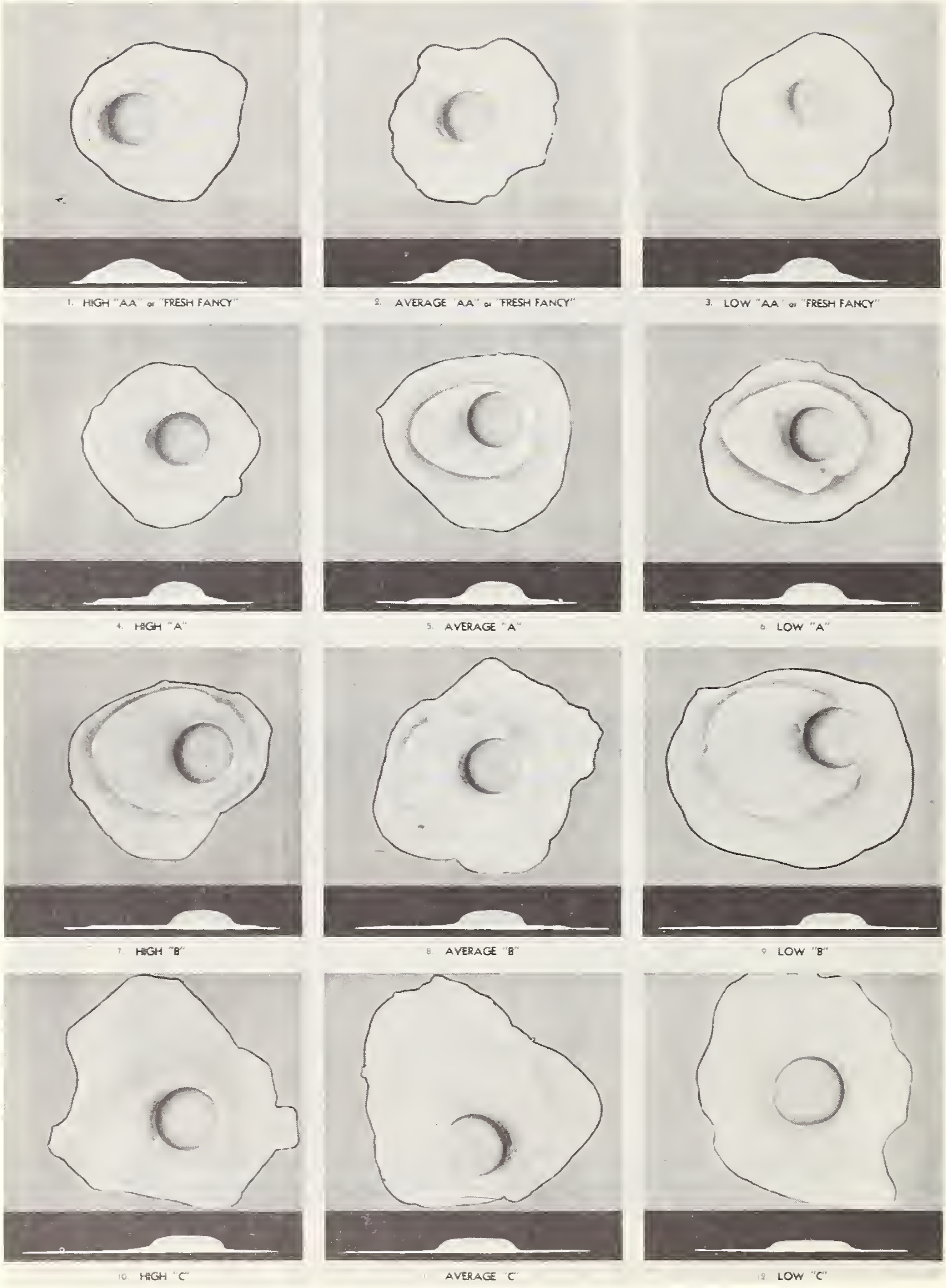
BN 6350
BN 6351

Figure 6.--The Egg Quality Slide Rule



DN 1360

Figure 7.--The "Van Wagenen" or "Cornell" chart showing fresh eggs of high quality in the top row, medium quality in the middle row, and low quality in the bottom row.



1. HIGH "AA" or "FRESH FANCY"
2. AVERAGE "AA" or "FRESH FANCY"
3. LOW "AA" or "FRESH FANCY"
4. HIGH "A"
5. AVERAGE "A"
6. LOW "A"
7. HIGH "B"
8. AVERAGE "B"
9. LOW "B"
10. HIGH "C"
11. AVERAGE "C"
12. LOW "C"

DN 1815

Figure 8.--Black-and-white reproduction of U. S. Department of Agriculture color chart showing eggs by grades of interior quality specified in U. S. standards of quality.

When determining albumen quality with a micrometer, select a flat area in the surface of the widest expanse of the thick white for measurement. Eggs with very high albumen will not have a flat surface and in such cases a point about halfway between the yolk and the edge of the widest expanse of thick white should be selected. Care should be taken to avoid measuring areas over an air bubble or chalaza. The measuring rod should be rolled down slowly until it makes contact with the surface of the albumen and should be raised and cleaned before placing over the next egg to be measured.

The interior quality calculator (fig. 5) is used to determine the Haugh unit. The indicator for ounces per dozen or grams per egg is placed at a point coinciding with the weight of the egg. The pointer line is next moved to the appropriate albumen height reading and the Haugh unit reading is obtained and recorded to the nearest whole unit. The illustration in figure 5 is that of an egg weighing 24 ounces with albumen height of 5.5 and a Haugh unit reading of 74.

Egg quality slide rule.--The egg quality slide rule (fig. 6) is a simple, inexpensive device for measuring the interior quality of eggs, designed by Dr. A. W. Brant and K. H. Norris of the U. S. Department of Agriculture. With this plastic slide rule, one can determine albumen quality quickly. This instrument is quite satisfactory for use under other than laboratory conditions. Where large numbers of eggs are to be broken, the micrometer and the calculator will save sufficient time to make the investment in such equipment worth while. The slide rule measures the height of the thick white, and it calculates quality in four different scales according to the individual needs or preferences of the user. Haugh units, USDA quality score, USDA chart score, and the Van wagenen-Wilgus score for condition of firm albumen are shown simultaneously. Durably made of .03-inch white plastic, with clearly printed scales and instructions, the rule is a handy-sized ($1\frac{1}{2}$" x $7\frac{1}{2}$") instrument for checking interior egg quality.[4] Complete instructions in the use of the slide rule are sent with it.

Meat and Blood Spots

Since the tendency to produce eggs with blood and meat spots is a heritable characteristic, breeders will want to record the occurrence of these defects. Electronic equipment for removing eggs with blood spots is now being adapted for commercial use. Fairly satisfactory results are obtained, too, by flash candling.

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[4] The Poultry Division, Agricultural Marketing Service, Washington 25, D. C., will furnish names of known suppliers of this equipment on request.

Measuring Yolk Quality

As a general rule, the "standup" quality of the yolk in new-laid or fresh eggs is not a problem. Mottling, discolorations and other defects are sometimes encountered. An occasional hen will lay eggs with an off odor. The breeder should examine the yolk carefully and also smell the opened shell when breaking eggs and recording results. When the producer has such a problem, he should examine his feeding, management, and disease control methods to see whether corrective measures can be found.

The market man who finds serious yolk defects in the broken-out eggs will not want to put that producer's eggs into a top quality pack without carefully candling each egg.

Factors to Consider in Testing

Number of eggs to measure.--It is generally considered that the breeder can make satisfactory tests for albumen and shell quality by selecting 5 to 10 eggs per bird.

For blood and meat spot testing, larger samples are needed to give a better index of the bird's performance. In general, the lower the incidence the larger the sample needs to be. However, the eggs used for testing albumen quality can serve as a guide.

The most critical test of albumen and shell quality can generally be made when the hens have been in production over 12 months. A uniform procedure should be adopted, however, and it is recommended that birds being tested for breeding flocks be in production at least four months before quality determinations are made.

Statistical analysis of the quality variation found in eggs from flocks of uniform age and known heritage has shown that under controlled production and handling methods, a market man can select a very small random sample which will be highly accurate in reflecting the average quality of the lot. A sample of 5 to 10 eggs from a flock each week is large enough to assure the packer of a uniformly high quality egg after the eggs have been screened for defective shells and meat and blood spots.

Time required to test eggs.--After some practice, a fairly good operator can measure the Haugh units, measure the shell thickness, and record the blood and meat spots of 30 to 40 eggs an hour. An operator checking Haugh units and yolk condition only can handle 60 to 70 eggs.

Recording Results

Breeders will want to develop their own standards for selection and, as a consequence, their own record forms. Market men will also want to develop forms and sampling procedures in dealing with their producers. From a practical standpoint it is important that a farm survey be made and a current report and a running average report be kept of producers' eggs being delivered to the packing plant. The running average is generally computed by averaging the results of the latest four weekly entries, except that during the second and third weeks, the average is computed by averaging the latest entry with the previous entries.

The Poultry Division, Agricultural Marketing Service, has developed forms and procedures for recording results in connection with its Federal-State Grading Program for eggs to be identified as "Produced and Marketed under Federal-State Quality Control." The forms used for recording the necessary information for the program are illustrated in Exhibits A, B and C.

Exhibit A

FORM PY-28
(12-10-59)

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
POULTRY DIVISION

FARM AND FLOCK SURVEY

BUDGET BUREAU NO. 40-R3105
APPROVAL EXPIRES 12-31-60

DATE OF SURVEY

SURVEYOR *(Signature)*

TITLE

INSTRUCTIONS: Most of the items of information regarding facilities and egg-gathering and washing practices can be answered by observation. The intent is to obtain information on actual practices as currently being performed. To the extent that there is a variation in current practices of gathering or washing eggs, answers should reflect the range of such variations - - *e.g.*, lapsed time between gathering and cleaning, water temperature, length of soaking, etc.

PRODUCER'S NAME AND ADDRESS *(Street or RFD, City and State)*

NAME AND ADDRESS OF PLANT TO WHICH EGGS ARE SHIPPED *(Street or RFD, City and State)*

SECTION 1 – FARM FACILITIES

1. NUMBER OF TIMES PER DAY EGGS ARE GATHERED

2. METHOD OF GATHERING EGGS
   a. Gathered by hand, using: *(Check one)*
   ☐ TRAY ☐ WIRE BASKET ☐ PAIL ☐ CASE OR
   b. ☐ GATHERED BY CONVEYER

3. IF EGGS ARE GATHERED IN WIRE BASKETS, APPROXIMATE NUMBER GATHERED IN EACH BASKET

4. METHOD OF CLEANING EGGS
   ☐ WASHED ☐ DRY CLEANED

5. EXTENT OF EGG CLEANING
   ☐ ALL EGGS ARE CLEANED
   ☐ SOILED EGGS *ONLY* ARE CLEANED

6. LAPSED TIME BETWEEN GATHERING OF EGGS AND THEIR CLEANING
   ________ Hours

7. COMPLETE THIS QUESTION IF EGGS ARE WASHED
   a. Eggs are: *(Check one)*
   ☐ SOAKED ☐ SPRAYED
   b. Temperature of water used . . . . ________ °F
   c. Is water temperature thermostatically controlled?
   ☐ YES ☐ NO
   d. Is sanitation satisfactory *(equipment-water)*?
   ☐ YES ☐ NO
   e. How long are eggs soaked? . . . . ________
   f. How many baskets of eggs are washed before water is changed? . . . . ________
   g. Brand name of detergent used:
   ____

8. COMPLETE THIS QUESTION IF EGGS ARE DRIED *(Check one in Item a, and one in Item b)*
   a. Eggs are: *(Check one)*
   ☐ DRIED BY FAN
   ☐ ALLOWED TO DRY IN OPEN AIR *(No mechanical air circulation)*
   b. Eggs are: *(Check one)*
   ☐ DRIED IN COOLER
   ☐ DRIED OUTSIDE COOLER

9. SIZE OF COOLER
   Length ________ Ft. Width ________ Ft. Height ________ Ft.

10. TYPE OF COOLER *(Check one)*
   ☐ MECHANICAL ☐ NON-MECHANICAL *(natural)*

11. IS COOLER EQUIPPED WITH HUMIDITY CONTROL?
   ☐ YES ☐ NO

12. TEMPERATURE IN COOLER ________ °F

13. IS COOLER ADEQUATE IN HOT WEATHER?
   ☐ YES ☐ NO

14. HUMIDITY IN COOLER ________ %

15. IS COOLER CLEAN AND FREE OF MOLD?
   ☐ YES ☐ NO

16. METHOD OF SHELL TREATING *(Check one)*
   ☐ SPRAY ☐ DIP ☐ NOT TREATED

17. IF SHELL TREATED
   a. How soon after gathering? . . . . ________
   b. Is sanitation satisfactory *(equipment-material)*?
   ☐ YES ☐ NO

18. NUMBER OF TIMES PER WEEK EGGS ARE SHIPPED TO THE PLANT

19. CONTAINERS USED IN SHIPPING ARE *(Check one)*
   ☐ NEW ☐ GOOD USED ☐ POOR USED

20. ARE THE CONTAINERS PRECOOLED BEFORE EGGS ARE CASED?
   ☐ YES ☐ NO

21. IS MOISTURE ADDED TO CONTAINERS BEFORE EGGS ARE CASED?
   ☐ YES ☐ NO

(SEE REVERSE)

Exhibit A
(continued)

FORM PY-25 (REVERSE)

SECTION 2 – FLOCK INFORMATION

1. TYPE OF HOUSING *(Check one)*

☐ CAGE ☐ LITTER FLOOR ☐ SLAT FLOOR

2. NESTING FACILITIES *(Check one)*

☐ ROLLAWAY ☐ COMMUNITY ☐ INDIVIDUAL

3. IF INDIVIDUAL NESTING IS USED, NUMBER OF BIRDS PER NEST

4. IS NESTING MAINTAINED IN SANITARY CONDITION?

☐ YES ☐ NO

5. SIZE, CONDITION, ETC., OF FLOCK:

Flock No.	No. of Birds in Flock	Breed	Hatch Date *(Month and Year)*	Health Satisfactory	
				YES	NO
1					
2					
3					
4					

6. VACCINATION RECORD:

Flock No.	Vaccinated for	Date	Vaccinated for	Date	Vaccinated for	Date
1						
2						
3						
4						

7. AGE AT WHICH BIRDS IN FLOCK ARE REPLACED

_________ Months

REMARKS *(When referring to specific questions, refer to section and question by number.)*

Exhibit B

FORM PY-207
(5-26-59)

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
POULTRY DIVISION

WEEKLY EGG BREAKOUT

Date received		7/31/59			8/6	8/13	8/19	8/27	9/3	9/10	9/17	9/24	
No. cases		8			12	14	14	15	16	15	15	16	
Egg temperature		58°			57°	58°	59°	57°	57°	59°	60°	59°	
Date tested		7/31			8/7	8/13	8/20	8/27	9/4	9/11	9/18	9/24	
HAUGH UNIT	Egg 1	97	80	96	97	100	90	88	86	92	80	84	
	Egg 2	98	100	100	98	90	88	90	98	90	100	91	
	Egg 3	92	86	86	86	84	87	94	90	88	90	82	
	Egg 4	93	88	88	92	96	96	89	91	88	82	80	
	Egg 5	88	93	87	94	92	94	96	85	90	92	86	
	Egg 6	94	92										
	Egg 7	106	99										
	Egg 8	93	90										
	Egg 9	86	84										
	Egg 10	101	90										
Total Haugh Units				2308	467	462	455	457	450	448	444	423	
Weekly Average				92.3	93.4	92.4	91.0	91.4	90.0	89.6	88.8	84.6	
Moving Haugh Unit Total													
Moving Average				92.3	92.8	92.7	92.3	92.5	91.2	90.5	90.0	88.3	

PRODUCER'S NAME John Doe

FLOCK H.Q.-2

HATCH DATE Jan. 6, 1959

REMARKS:

Exhibit C

U.S. DEPARTMENT OF AGRICULTURE, AMS
GRADING BRANCH, POULTRY DIVISION

HAUGH UNIT CONVERSION CHART

(1-6-60)

HAUGH UNITS (MILLIMETERS)

Egg Weight	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	Egg Weight
18	2.8	2.9		3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2 4.3	4.4	4.5	4.6	4.7	18
19	2.9	3.0	3.1	3.2		3.3	3.4	3.5	3.6	3.7	3.8	3.9 4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8 4.9	19
20	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6 4.7	4.8	4.9	5.0	20
21	3.2	3.3		3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6 4.7	4.8	4.9	5.0	5.1 5.2	21
22	3.3	3.4	3.5		3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7 4.8	4.9	5.0	5.1	5.2 5.3	22
23	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1		4.2	4.3 4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	23
24	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	24
25	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	5.6	25
26	3.8	3.9		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	5.6	5.7 5.8	26
27	3.9	4.0	4.1		4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3 5.4	5.5	5.6	5.7	5.8 5.9	27
28	4.0	4.1	4.2	4.3		4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4 5.5	5.6	5.7	5.8	5.9 6.0	28
29	4.1	4.2	4.3	4.4		4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4 5.5	5.6	5.7	5.8	5.9	6.0 6.1	29
30	4.2	4.3	4.4		4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6 5.7	5.8	5.9	6.0	6.1 6.2	30
Egg Weight	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	Egg Weight

HAUGH UNITS

HAUGH UNITS (MILLIMETERS)

Egg Weight	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	Egg Weight
18	4.8 4.9	5.0	5.1	5.2 5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6 6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	18
19	5.0	5.1	5.2 5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6 6.7	6.8	6.9 7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	19
20	5.1 5.2	5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1	6.2 6.3	6.4 6.5	6.6	6.7 6.8	6.9 7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4 8.5	20
21	5.3	5.4	5.5	5.6 5.7	5.8	5.9 6.0	6.1	6.2 6.3	6.4	6.5 6.6	6.7	6.8 6.9	7.0 7.1	7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	21
22	5.4	5.5	5.6 5.7	5.8	5.9	6.0 6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	22
23	5.5	5.6	5.7 5.8	5.9	6.0 6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4	8.5 8.6	8.7 8.8	23
24	5.6	5.7 5.8	5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6	6.7 6.8	6.9	7.0 7.1	7.2 7.3	7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	24
25	5.7 5.8	5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6	6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	25
26	5.9	6.0	6.1	6.2 6.3	6.4	6.5 6.6	6.7	6.8 6.9	7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	26
27	6.0	6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4	7.5 7.6	7.7 7.8	7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	9.2 9.3	27
28	6.1	6.2	6.3 6.4	6.5	6.6	6.7 6.8	6.9	7.0 7.1	7.2	7.3 7.4	7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	9.3 9.4	28
29	6.2	6.3	6.4 6.5	6.6	6.7	6.8 6.9	7.0	7.1 7.2	7.3	7.4 7.5	7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	9.2 9.3	9.4 9.5	29
30	6.3	6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	9.3 9.4	9.5 9.6	30
Egg Weight	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	Egg Weight

HAUGH UNITS

Temperature and Humidity

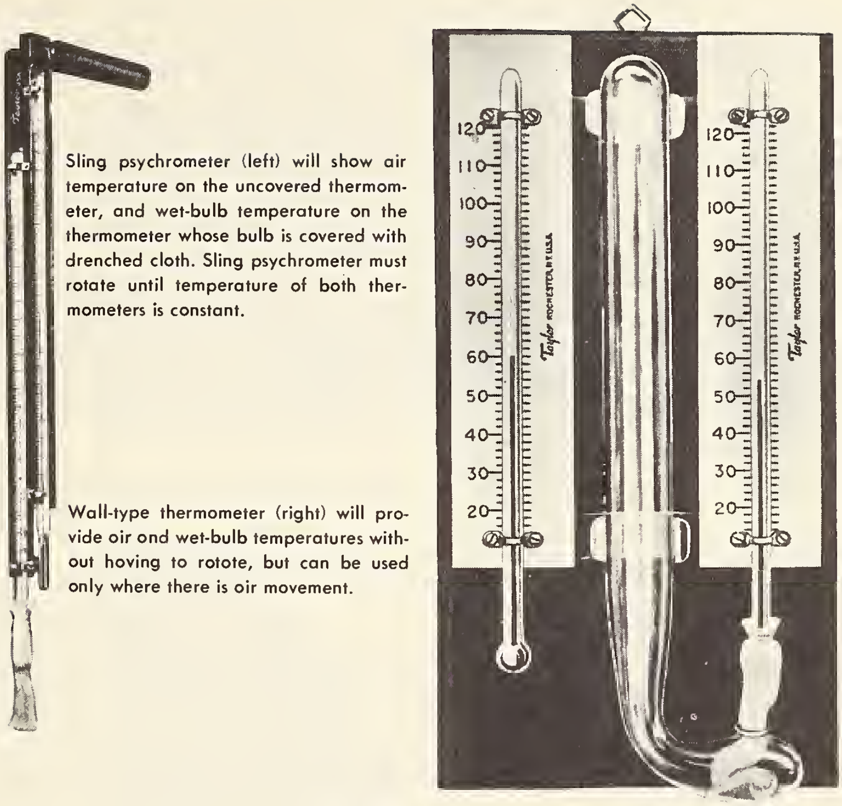
Successful operation of a quality control program depends greatly on the holding conditions at the farm, packing plant, and distributing level. Proper handling requires that attention be given to temperature, relative humidity, and dew point. These are also important factors in maintaining high hatchability rates.

Relative humidity is the ratio of the quantity of water vapor actually present in the air to the greatest amount possible at a given temperature. Complete saturation of the air is designated by 100, partial saturation is indicated by smaller numbers.

Dew point is the temperature at which the moisture in the air will condense out as liquid water. When the relative humidity is high the dew point will be nearly the same as the air temperature. When the temperature of an egg is below the dew point of the air surrounding it, moisture condenses on the egg. Such "sweating" increases the possibility of bacterial infection and may be avoided by proper temperature control.

The wet-bulb thermometer is a convenient device for measuring relative humidity. It is an ordinary thermometer with the bulb covered by a moistened wick. Care must be taken to keep the wick clean and supplied with water at all times. Distilled water is preferable. Soluble salts and dirt particles accumulated on the wick prevent it from functioning properly, causing inaccuracies in the wet-bulb readings. Wash the wicks frequently; discard and replace when the wick becomes hard.

Figure 9 illustrates a sling psychrometer and wall-type thermometer for recording air temperatures and wet-bulb temperature.



Sling psychrometer (left) will show air temperature on the uncovered thermometer, and wet-bulb temperature on the thermometer whose bulb is covered with drenched cloth. Sling psychrometer must rotate until temperature of both thermometers is constant.

Wall-type thermometer (right) will provide oir ond wet-bulb temperatures without hoving to rotote, but can be used only where there is oir movement.

BN 6212

Figure 9.--Sling psychrometer and wall-type thermometer.

How to measure relative humidity and dew point.--First establish wet-bulb temperature and dry-bulb (or air) temperature with either a sling or a wall-type psychrometer. Then apply these temperatures to the psychrometric graph to find relative humidity and dew point.

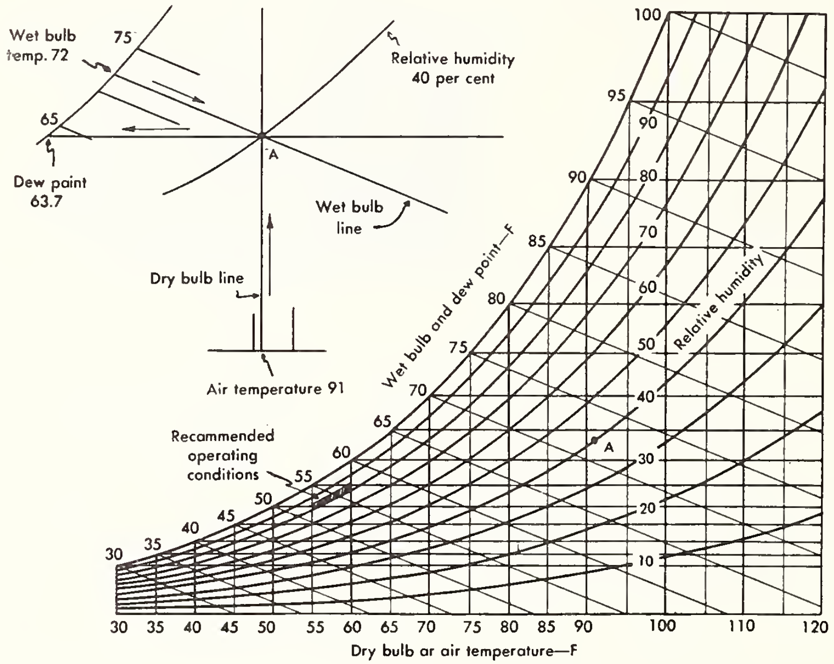
To find relative humidity: Follow vertical dry-bulb line to intersection with wet-bulb line (slanted from upper left to lower right). Intersection of the two lines gives you relative humidity on curved line.

To find dew point: After having established intersection for relative humidity, follow horizontal line to figures on the left of graph to find dew point.

Example: Suppose air temperature is 91° F. and wet-bulb temperature is 72° F. If you follow vertical air-temperature line at 91 and wet-bulb temperature at 72, you will find they intersect at point A, indicating a relative humidity of 40 percent on the curved line. Moving from point A horizontally to figures on the left, you will find dew point at 63.7° F. For better orientation the example is enlarged in the upper left corner of the graph.

In the case illustrated in the example, water will condense on eggs when removed from storage at a temperature of 63.7° F. or colder.

Since farm eggs should be cooled to at least 60° F., packaging rooms having a relative humidity of 70 percent (wet-bulb reading of 64° F.) must be cooled to at least 70° F. If the relative humidity is higher, the temperature must be lowered to prevent sweating.



BN 6211

Figure 10.--Chart for establishing relative humidity and dew point.

The Federal-State Quality Control Program

Requirements for eggs packaged under Fresh Fancy Quality grade mark.

(a) Minimum requirements of procurement and distribution program. Each packing station or plant must have a satisfactory procurement and distribution program including, but not being limited to, the following requirements at the farm and retail store level as applicable:

(1) Eggs from each flock must be packed separately and the shipping cases marked so as to facilitate segregation at the packing station. A flock consists of birds not varying in age by more than 60 days. In operations with a continuous replacement procedure, such as in cage operations, birds must be grouped together in accordance with the above requirements.

(2) Eggs should be gathered from the nest at least twice, and preferably, three times a day.

(3) Eggs which require cleaning should be cleaned in accordance with the following requirements:

- Shell egg cleaning equipment must be kept in good repair and must be cleaned after each day's use or more frequently if necessary.
- The wash water temperature must always be warmer than the eggs.
- The wash water must be replaced frequently and the detergent and sanitizer must be kept at an effective level at all times.
- Washed eggs must be dry before casing.

(4) Eggs may be treated by oil dipping, oil spraying, or oil-emulsion spraying: Provided, That methods used are such as will not cause objectionable cloudiness in the whites. Oil treating and cleaning operations must be in compliance with the following requirements:

- Shell egg treating (oil processing) operations must be conducted in a manner that will avoid contamination of the product and maximize conservation of its quality.
- Eggs with apparent moisture on the shell may not be shell treated.
- The processing oil must always be warmer than the eggs.
- Oil having any off odor, or that is obviously contaminated, may not be used in shell egg treatment.

- Processing oil that has been previously used and which has become contaminated must be filtered and heat treated at 180° F. for three minutes prior to use.

- Shell egg processing equipment must be washed, rinsed, and treated with a bactericidal agent each time the oil is removed. It is preferable to filter and heat treat processing oil, and clean processing equipment daily when in use.

- Adequate coverage and protection against dust and dirt must be provided when the equipment is not in use.

(5) Eggs must be cooled immediately after gathering to 60° F., or below and held at a reasonably constant temperature not to exceed 60° F., and a relative humidity of approximately 70 percent.

(6) Eggs must be transported and handled under such conditions as will prevent sweating and so as to reach the packing plant or store with an internal temperature of 60° F. or below.

(7) The temperature at which the eggs are held and displayed at the retail store must not exceed 60° F.

(8) Periodic checks to determine the adequacy of the production and distribution programs must be made by Government graders.

(b) Minimum requirements at time of packaging.

(1) Quality of eggs is to be determined by the broken-out score, measured in Haugh units, and the condition of the yolk. The break-out test is to be accomplished at the assembly plant or at the farm in the event the eggs go directly from the farm to the store. Eggs that do not meet the requirements of AA Quality with respect to shell texture or shape will not be selected as part of any sample that is to be broken-out and scored.

(2) The internal temperature of the eggs must not exceed 60° F. at the beginning of the packaging operations.

(3) A flock may be eligible for entry under the program when a sample of 25 eggs drawn at random averages 76 Haugh units or higher; or when two samples of 25 eggs each drawn at random (one sample per week for two consecutive weeks) each averages 73 Haugh units or higher. Notwithstanding the foregoing, a flock will not be eligible if any sample contains more than one egg measuring less than 55 Haugh units. The yolk of all eggs in the sample must have a well-rounded appearance with a reasonably uniform color.

(4) A flock may remain on the program: Provided, That (i) a moving average of 72 Haugh units or higher is maintained; (ii) that no individual weekly average is below 68 Haugh units; (iii) that not more than one of any two

consecutive weekly averages falls below 70 Haugh units; (iv) that the yolks of all eggs have a well-rounded appearance with a reasonably uniform color; and (v) that not more than one egg in any sample of 10 eggs or more measures less than 55 Haugh units.

(5) The weekly average will be computed by averaging the results obtained when testing eggs in accordance with either subparagraph (i) or (ii) of this paragraph. Samples will be drawn at random once a week per flock from a single shipment. The yolk of all eggs in the sample must have a well-rounded appearance with a reasonably uniform color.

(i) A sample of 10 eggs will be tested when the moving average is below 78 Haugh units and not more than one egg in the sample measures less than 55 Haugh units.

(ii) A sample of 5 eggs will be tested when the moving average is 78 Haugh units or above and the sample contains no eggs which measure less than 55 Haugh units. If only one egg measures less than 55 Haugh units, an additional 5 eggs will be tested. If this second 5-egg sample contains no eggs below 55 Haugh units, the average of the 10 eggs will be used in determining the weekly average.

(6) The moving average will be computed by averaging the results of the latest four weekly Haugh unit entries of a flock, except that during the second and third weeks after admission to the program, the average will be computed by averaging the latest entry with the previous weekly entries.

(7) Any flock which has been on the program and is excluded for failure to meet the requirements may be reinstated by the same procedures used to originally enter a flock on the program.

(8) Eggs that meet the foregoing provisions may be packaged and officially labeled with either of the marks illustrated in Figures 11 and 12, after loss eggs and those with blood spots, meat spots, and checks, and those with shell failing to meet the requirements for AA Quality have been removed. The packaged product must be identified with the proper size and packed in accordance with the regulations.

(9) Packages or sealing tapes must bear in distinctly legible form a date, stated as the month and day or the number of the month and day, preceded by the letters "Exp.," or a statement such as "Not to be sold after." The date may not exceed 10 days from date of Haugh unit test, including the day of testing. Upon expiration of the 10 days, the eggs must be removed from the labeled packages or the official grade mark must be completely obliterated.

(10) Sampling, break-out testing, and maintenance of records of break-out tests must be done by or under the immediate supervision of a Government grader.

Such graders will make examinations of all packaged product to observe compliance with U. S. Grade AA standards for shell conditions, loss, and foreign material, such as blood and meat spots. The size of the samples must be on the basis of the following:

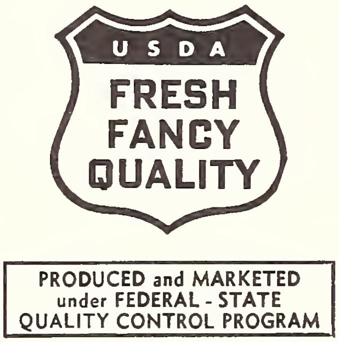
Mimimum Number of Cases Comprising a Representative Sample

Cases in lot:	Cases in sample
1 case	1
2 to 10, inclusive	2
11 to 25, inclusive	3
26 to 50, inclusive	4
51 to 100, inclusive	5
101 to 200, inclusive	8
201 to 300, inclusive	11
301 to 400, inclusive	13
401 to 500, inclusive	14
501 to 600, inclusive	16

For each additional 35 cases, or fraction thereof, in excess of 600 cases, one additional case shall be included in the sample.

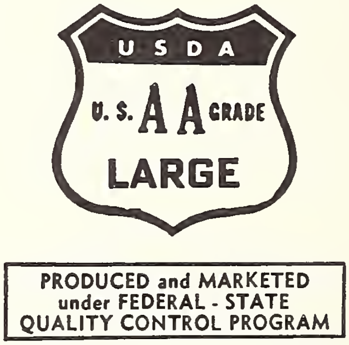
Fresh Fancy Quality or AA Grade Mark.

Eggs which are packaged under these requirements and are to be grade marked are labeled with one of the following grade marks:



BN 8681

Figure 11.



BN 8677

Figure 12.

Requirements for eggs packaged under the U. S. Grade A mark.

Eggs packaged with the grade lable designation specified in figure 13 must meet all of the provisions required for Fresh Fancy or Grade AA except for the following:

(a) A flock consists of birds located on the same farm and managed under identical supervision.

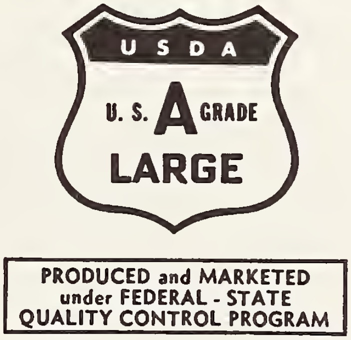
(b) A flock may be eligible for entry under the program when a sample of 25 eggs drawn at random averages 64 Haugh units or higher; or when two samples of 25 eggs each drawn at random (one sample per week for two consecutive weeks) each averages 61 Haugh units or higher. Notwithstanding the foregoing, a flock will not be eligible if any sample contains more than four eggs measuring less than 55 Haugh units. The yolk of all eggs in the sample must have a well-rounded appearance with a reasonably uniform color.

(c) A flock may remain on the program: Provided, That (1) a moving average of 60 Haugh units or higher is maintained; (2) no individual weekly average is below 55 Haugh units; (3) the yolks of all eggs have a well-rounded appearance with a reasonably uniform color; (4) not more than two eggs in any sample of 10 eggs measure less than 55 Haugh units.

(d) The weekly average will be computed by averaging the results obtained by testing 10 eggs per flock per week. Samples will be drawn at random once a week.

Grade A Mark.

Eggs which are packaged under this program and are to be grade marked are labeled with the grade mark shown in Figure 13.



BN 8676

Figure 13.